REMARKS

Claims 1 - 37 are pending in the present application. New claims 38 and 39 have been added.

Applicant notes with thanks and appreciation that claims 3 – 7 and 9 – 31 are allowed and that claims 32 – 37 were found to have allowable subject matter if rewritten or amended to overcome the rejection under 35 USC §112, first paragraph.

The specification has been amended to correct a typographical error that occurred in the translation of the original Swedish application (SE 9701265-2 filed 4 April 1997) into English. The PCT application (PCT/SE98/00613 filed 3 April 1998) in Swedish has text corresponding to "direct electricity." Accordingly, no new matter has been added.

Claims 32 – 27 were rejected under 35 USC §112, first paragraph as failing to comply with the written description requirement. The Examiner asserted that there was not support in the specification for the limitations that "the start of the welding operation is considered to be the instant when the welding probe is inserted into the joint." Support for the claim limitations can be found at for example Specification at page 3, lines 29 - 31. Accordingly, Applicant respectfully asserts that claims 32 – 37 meet the written description requirement.

Claims 1 and 8 were rejected under 35 USC §102(e) as being anticipated by US Patent No. 5829664 (*Spinella*) and claim 2 was rejected under 35 USC §103(a) as being obvious over *Spinella*.

Spinella does not teach or suggest a method of friction stir welding with all the limitations of claim 1. In fact, Spinella teaches away from the claimed invention.

Claim 1 recites among other limitations that "additional heat is supplied to the joint prior to and/or during the welding operation, in excess of the frictional heat generated in the joint from the rotation of the welding means and of any other heat that may be supplied to the joint in any other manner by the welding means."

Spinella does not teach or suggest the method of independent claim 1. The examiner asserts that *Spinella* teaches "heat from the electrical resistance heating can be supplied during welding by using heating through the rotating welding tool or prior to welding by using an electrode that advances ahead of the tool." There is no teaching or suggestion in *Spinella* that "additional heat is supplied to the joint prior to and/or during the welding operation" and that the additional heat is "in excess of the frictional heat generated in the joint from the rotation of the welding means and of any other heat that may be supplied to the joint in any other manner by the welding means" The Examiner asserts that the heat is supplied by a means other than the welding means because current is supplied by the electrode:

> 'Electrical current can flow directly through the tool, pin and workpiece into a metal table supporting the workpiece below the location of the toll and pin, or electrical current can be applied by an electrode engaging the workpieces either ahead of or behind the stile tool, with current flowing linearly through the workpiece between the electrode and tool' (column 1, lines 39 – 45). So, the heat can be applied, supplied by either the pin or the electrode. If the current is supplied by the electrode it reads on claims 1 and 8. [Official Action dated 1 April 2005 citing *Spinella*]

Applicant respectfully asserts that the Examiner is misunderstanding what is occurring in *Spinella*. Current alone does not produce heat. Current plus resistance produces heat. Even when current is supplied by the electrode, the welding means is needed to produce resistive heat because the welding means closes the electrical current path. Thus, the welding means in *Spinella* supplies the heat as it is needed for heat to be generated. *Spinella* does not teach or suggest heat supplied by any means other than the welding means. Further, *Spinella* only teaches or suggests supplied in an area substantially adjacent to the welding means and teaches away from heating the workpieces anywhere other than immediately next to the probe.

As is evident from passages throughout the *Spinella* specification, there is no teaching or suggestion of intentional heat transfer at the workpieces at any other point than at the pin of the welding means. For example:

> The present invention solves the problem of slow travel speeds of stir welding processes (without decreasing the quality of the welds effected**), by heating the metal of the workpieces immediately adjacent the rotating stir tool with electrical resistance occurring between the stir tool and workpieces**. [*Spinella* at Column 1, lines 32-37 (emphasis added)].

> Electrical current is **supplied to a stir pin** 10 of a rotating tool 12 **to provide heat via electrical resistance between the pin and abutting edges of two workpieces** 14. The heat of electrical resistance is supplied directly to a stir welding process . . . [*Spinella* at Column1, line 66 to Column 2, line 4 (emphasis added)].

> The properties of the **remaining portions of the workpieces can be maintained by keeping bulk temperatures relatively cool**. These objectives are particularly important in welding aluminum alloy workpieces.
>
> Stir welding can particularly provide a quality seam weld since **the heat generated to effect the weld is substantially confined to those portions (edges) of the workpieces actually being melted and welded.**" [*Spinella* at Column 2, lines 38-45 (emphasis added)].

> The **heat affected zone** of the abutting workpieces **is limited essentially to** the area of the workpieces located **beneath rotating tool 12**. . .[*Spinella* at Column 2, lines 64-66 (emphasis added)].

> The amount of electrical current flowing to and through the tool and workpieces.
>
> In this latter regard, the flow of electrical current can be **further confined to pin 10 by using an electrically insulating, heat resistant layer (washer)** of material 25 located on the flat working end of tool 12. This directs current flow to pin 10 and the edge material of abutting workpieces 14. **This limits, in turn, the location and generation of electrically resistive heat to the pin and workpiece edges, which is where welding heat is needed and used. The bulk remainder of the workpiece material remains relatively cool.** [*Spinella* at Column 3, lines 2-12 (emphasis added)].
>
> Again, **current flow is limited to the vicinity of pin 10 and the abutting edges of workpieces 14** if insulating washer 25 is used on the working end of tool 12. [*Spinella* at Column 3, lines 40-42 (emphasis added)]

In *Spinella*, the resistance is concentrated at the probe. For example, *Spinella* teaches using an isolating disk to make the contact area as small as possible to concentrate the resistance and thus the heat at the probe. The claims of *Spinella* further demonstrate that any heat is generated at the pin by the welding means and only during welding.

Applicant respectfully asserts that the current in *Spinella* can be AC current does not change the analysis as the welding means is still needed to close the path in order for resistive heat to be produced and the heat is still limited to areas substantially adjacent to the welding means.

Should any heat be generated in an area other than at the probe (at for example the roller) of *Spinella* such heat would also be **supplied by the welding means**. Because current and resistance are needed for heat, no heat can be supplied until the probe is lowered into the joint and the circuit closed. Accordingly, the welding means is an essential element for the generation of heat and closing the circuit is an example of "another manner" in which heat is supplied by the welding means. Any heat generated by closing the circuit is supplied by the welding means and is not in excess of "any other heat that may be supplied to the joint in any other manner by the welding means."

Spinella teaches that it is undesirable to heat more than the portion immediately surrounding the probe.

> **Bulk heating the workpieces does not suffice because the coefficient of friction is lowered between the stir tool and the workpieces, which reduces the buildup of heat from the friction of the stirring process. It is also desirable to maintain the bulk temperature of each workpiece relatively cool to avoid reducing the properties of the base metal of the workpieces.** [*Spinella* at col. 1, lines 16 – 22 (emphasis added)]

> The properties of the **remaining portions of the workpieces can be maintained by keeping bulk temperatures relatively cool**. These objectives are particularly important in welding aluminum alloy workpieces.
>
> Stir welding can particularly provide a quality seam weld since **the heat generated to effect the weld is substantially confined to those portions (edges) of the workpieces actually being melted and welded**." [*Spinella* at Column 2, lines 38-45 (emphasis added)].
>
> The **heat affected zone** of the abutting workpieces **is limited essentially to** the area of the workpieces located **beneath rotating tool 12**. . .[*Spinella* at Column 2, lines 64-66 (emphasis added)].

It is common in friction stir welding to cool the probe for even heating along a joint and to prolong the service life of the probe. One of the disadvantages of traditional friction stir welding that the present invention addresses is the relatively short service life of the probe due to thermal fatigue. Thermal fatigue would be increased in the *Spinella* apparatus as the probe is hotter than the heat generated by friction alone due to the additional heat.

Another problem with traditional friction stir welding that the present invention addresses is the generation of short, deep cracks in the surface of the backing means due to thermal fatigue. The cracks tend to develop in the transverse direction. The joint adopts the appearance of the backing means surface due to plasticization. As a result, cracks in the backing means are manifested as protrusions on the lower face of the joint. Because heat is concentrated at the probe in *Spinella*, thermal fatigue and the associated problems including cracks in the backing means are worsened.

Because Spinella does not teach or suggest a method with all the limitations of claim1, claim 1 is patentable.

Claim 2 depends from claim 1, thus claim 2 is also patentable for the reasons discussed above. Further, *Spinella* does not teach or suggest preheating the joint. In *Spinella*, all intentional heat is supplied by the welding means. Because the additional heat according to *Spinella* cannot be supplied prior to the welding operation as the electrical path at that time is not closed. The heating in *Spinella* only occurs when the welding means closes the electrical path, thus generating heat. Thus, *Spinella* does not teach or suggest a method with all the limitations of claim 2 and claim 2 is patentable over *Spinella*.

Independent claim 8 is an apparatus for friction stir welding. Claim 8 recites among other limitations that in the apparatus "additional heat is supplied to the joint prior to and/or during the welding operation" and that the additional heat is "in excess of the frictional heat generated in the joint from the rotation of the welding means and of any other heat that may be supplied to the joint in any other manner by the welding

means." For the reasons discussed above with respect to claim 1, *Spinella* does not teach or suggest a friction stir welder with all the limitations of claim 8. Thus, claim 8 is patentable.

Accompanying this response is $400 to cover the cost of the additional independent claims.

CONCLUSION

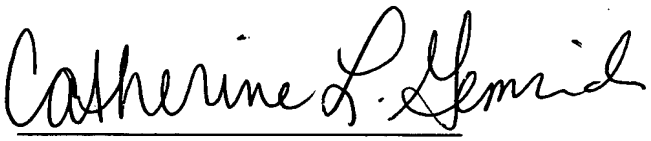
Having obviated the Examiner's objections, Applicant hereby seeks an early indication of allowance.

REQUEST FOR EXTENSION OF THE TERM

Applicant respectfully requests an extension of the normal term that expired on 1 July 2005 for three months months, to 1 October 2005 which is a Saturday. Accordingly, the response is timely filed on Monday 3 October 2005..

Accompanying this response is $1020 to cover the cost of the extension. Any deficiency or overpayment should be charged or credited to Deposit Account Number 04-2219, referencing our Docket Number 5746.

Respectfully submitted,



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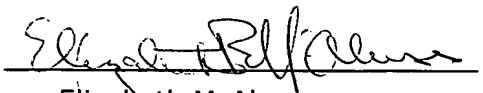
CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Commissioner of Patents PO Box 1450, Alexandria, VA 22313-1450, on October 3, 2005.



Elizabeth McAleese